CORRELATION OF TEPHRA DEPOSITS IN LAKE SEDIMENT RECORDS, LAKE CLARK NATIONAL PARK, ALASKA

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Introduction

Extensive Holocene volcanic activity along the Eastern Aleutian Volcanic Arc and Cook Inlet has deposited numerous tephra layers on the Alaska Peninsula. These ash deposits form stratigraphic markers useful in regional paleoenvironmental reconstruction and contain information regarding the physical characteristics of source magma. This information can be used to reconstruct the timing, frequency, and nature of regional eruptive events. In the Lake Clark region, this information is often preserved in low energy lake basins abundant in the region and can be extracted from the sedimentary record for dating and analysis. The primary objectives of this study are:

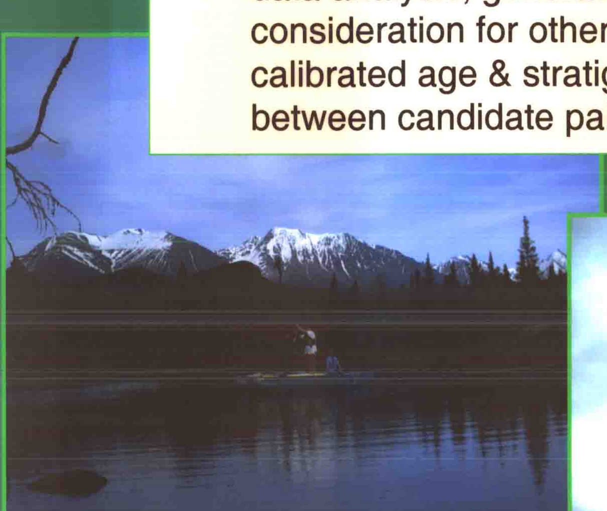
1) Use tephras preserved in lake sediments to construct a tephrochronological record of the LACL area.
2) Using a multi-parametric approach to correlation, attempt to connect the LACL tephra record to related studies beyond the park boundary.

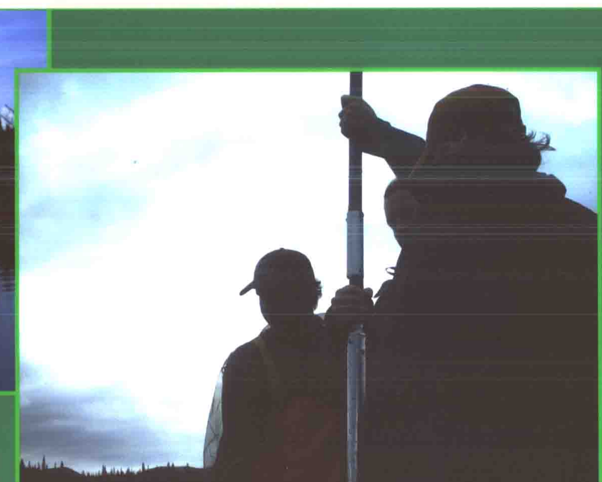
An extensive and well executed tephra study within the Lake Clark National Park and Preserve will allow for the construction of a local tephra stratigraphy, but will also augment future studies and contribute to an improved understanding of regional volcanic history. The selection of sites along a geographic transect (generally NE to SW along axis of Lake Clark) may provide additional information about tephra air fall extent and preservation with regard to topography and distance from source.

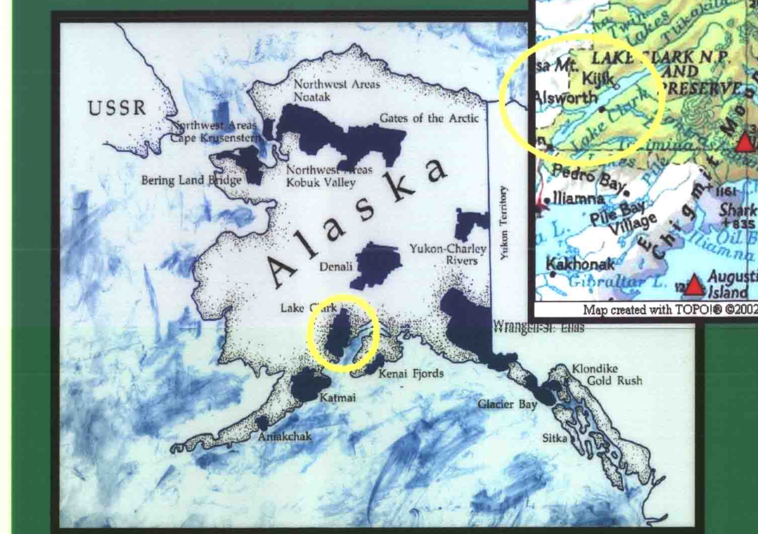
Methods

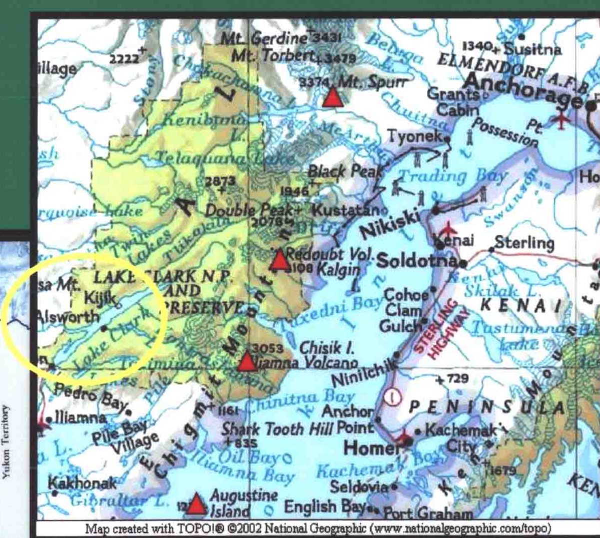
In the field, sites were selected using aerial photos and onsite reconnaissance. Samples were collected using a Modified Livingston Piston coring device deployed from a floating platform. Field observations were recorded at the time of core extraction, making note of stratigraphy in particular, sediment composition, tephra horizon depth, thickness, color, grain size, coherency, bedding, and contacts.

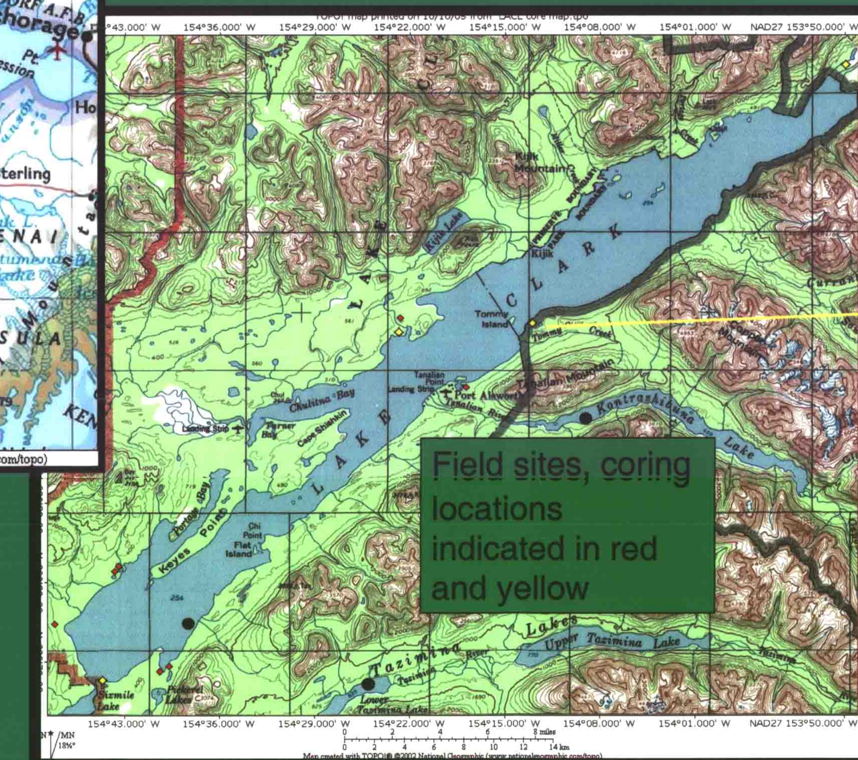
In the laboratory we measured the down core magnetic susceptibility (MS), split cores for sampling, produced a second detailed description and photographed each section. After sampling prominent tephra horizons, the sample is wet sieved to clean and retain a usable size fraction. Samples are homogenized then density separated using a calibrated heavy liquid (SPT). Following permanent mounting of the separated material, primarily glass shards and feldspar minerals, samples are analyzed using electron microprobe assess the point specific chemistry of individual glass shards. After rigorous data analysis, generation of correlation matrices, and consideration for other physical parameters, i.e. (AMS calibrated age & stratigraphic control), confident correlations between candidate pairs should be established



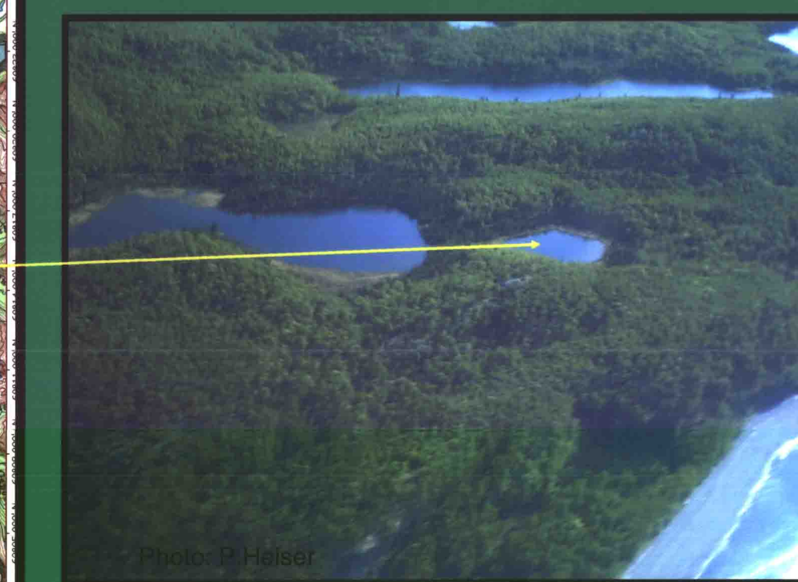




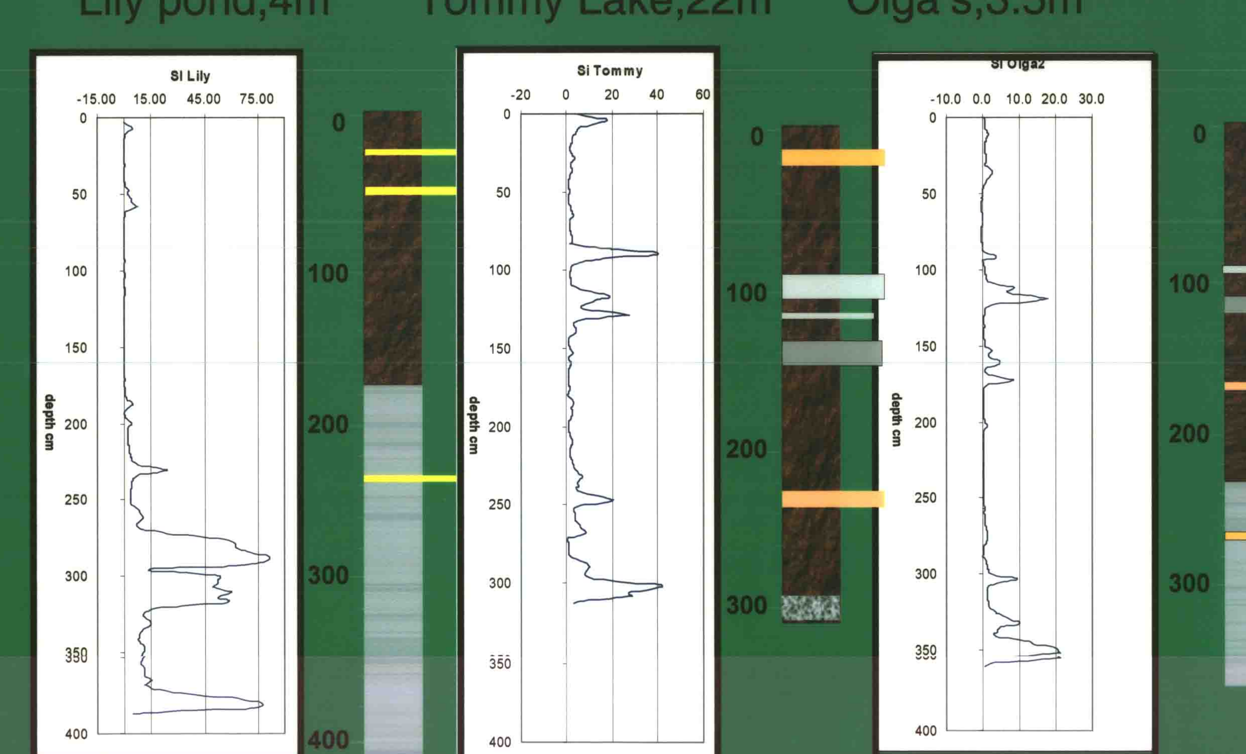




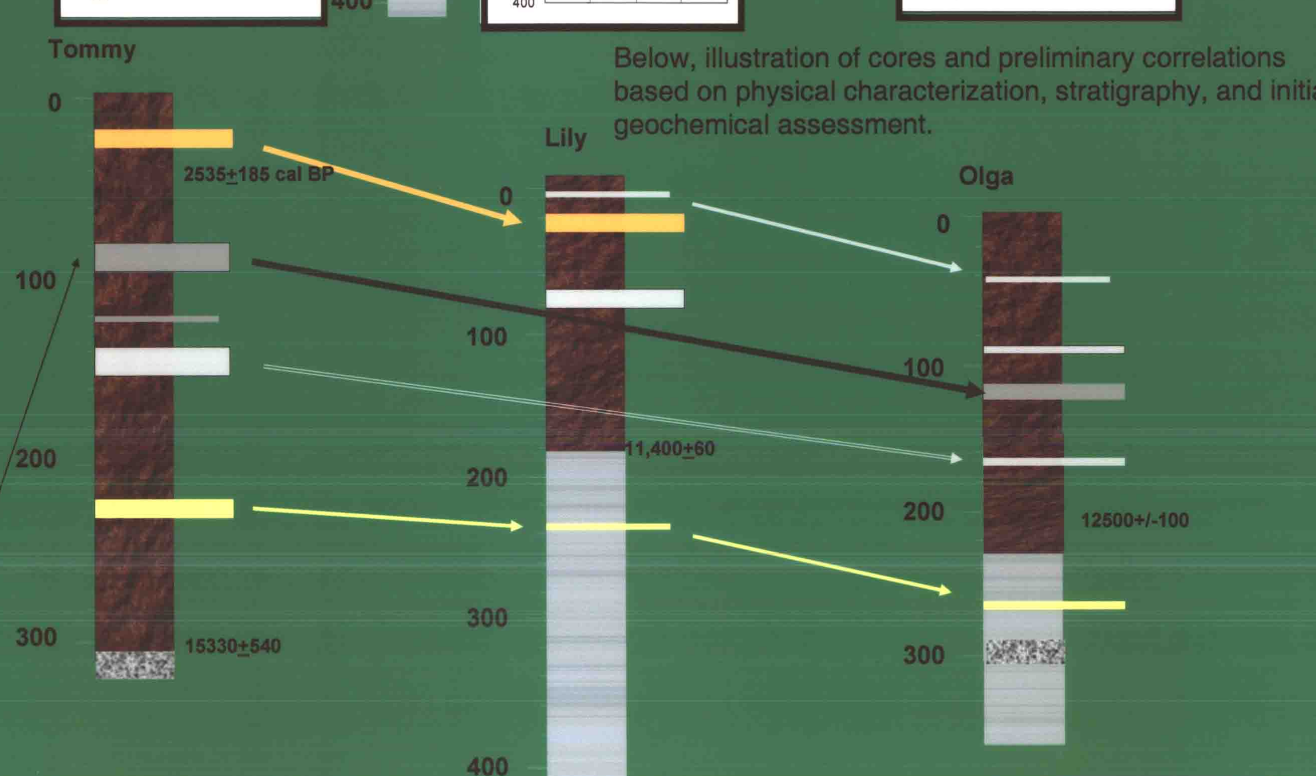
Aerial view of Tommy lakes



Graphs showing Magnetic susceptibility , lake name, and elevation above Lake Clark.



Below, illustration of cores and preliminary correlations based on physical characterization, stratigraphy, and initial geochemical assessment.

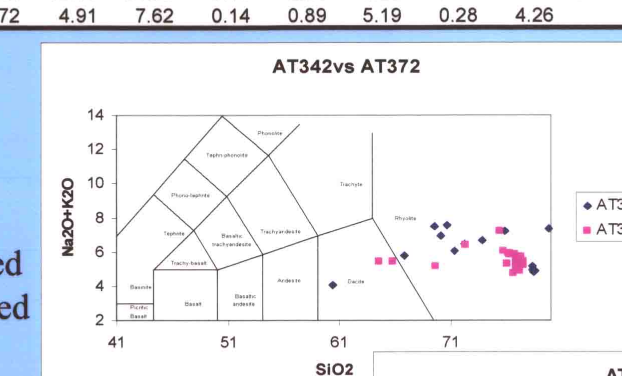


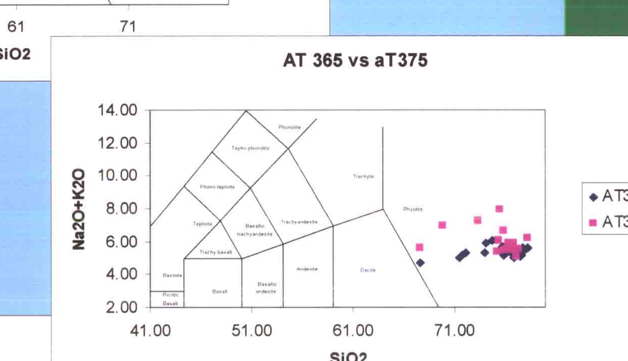
Geochemical data

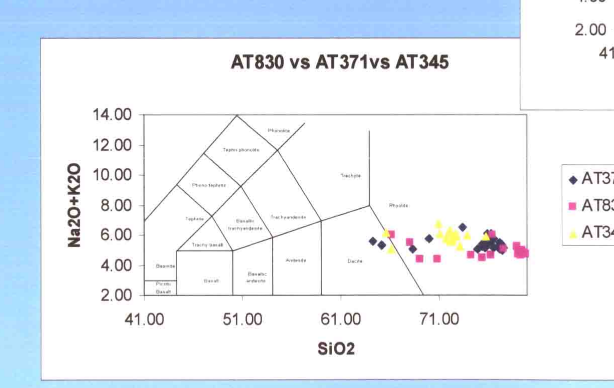
Chemical composition of > 40 glass shards were obtained for each sample in order to ensure accurate characterization of the population and aide in assessing modal distribution of sample chemistry. Quantitative major oxide wt % was established by wave dispersive x-ray spectrometry. Analyses were carried out with spectrometer beam conditions set for 15kv accelerating voltage, 10 nA, and 10µm diameter for 20 seconds

Normalized											
smpl#		Na20	MgO	Al2O3	SiO2	Cl	K2O	CaO	TiO2	FeO	Location/cm
	375 Ave	3.53	0.53	12.93	77.06	0.26	1.56	2.18	0.31	1.63	Olga 108
n=26	SD	0.39	0.70	0.64	3.65	0.12	0.12	0.35	0.34	0.59	
	374 Ave	3.98	0.55	12.57	76.14	0.17	1.72	2.46	0.55	1.86	Olga 96
n=24	SD	1.31	0.49	3.37	7.90	0.10	0.70	1.04	0.67	1.34	
	368 Ave	4.91	0.44	13.33	75.57	0.19	1.56	2.24	0.29	1.48	Tom 136
n=26	SD	0.36	0.09	0.71	1.62	0.04	0.08	0.47	0.22	0.32	
	364 Ave	4.21	1.06	12.76	75.00	0.20	1.56	3.06	0.22	1.92	Tom 97
n=25	SD	0.89	1.66	1.64	3.65	0.04	0.22	2.50	0.17	1.06	
	370 Ave	4.01	0.63	13.72	74.59	0.19	1.61	2.91	0.41	1.93	Tom 139
n=31	SD	0.49	0.38	2.54	5.42	0.10	0.35	1.54	0.62	0.71	
	367 Ave	5.12	0.55	13.26	74.48	0.20	1.77	2.36	0.36	1.91	Tom 127
n=19	SD	0.60	0.31	1.10	5.10	0.06	0.41	0.43	0.26	1.08	
	376 Ave	4.44	0.48	14.11	73.93	0.24	1.66	3.24	0.25	1.65	Olga 114
n=25	SD	0.87	0.39	4.28	12.14	0.10	0.57	2.13	0.19	0.55	
	830 Ave	6.07	0.66	15.34	69.26	0.17	2.45	3.05	0.37	2.62	Olga 275
n=10	SD	1.04	0.25	2.67	4.52	0.13	1.15	1.42	0.21	0.47	
	835 Ave	6.27	1.24	15.38	66.15	0.17	2.37	2.96	1.13	4.32	Taz 114
n=18	SD	1.51	0.46	2.04	3.86	0.09	0.31	0.60	0.58	1.34	
	348	5.19	3.79	12.81	65.24	0.17	2.18	5.81	0.75	4.07	Tom 43
n=14	SD	2.24	6.01	5.18	8.01	0.17	1.03	5.82	0.75	2.84	
	347 Ave	5.69	4.02	13.15	64.33	0.19	2.21	5.39	0.37	4.64	Tom 38
n=24	SD	2.07	6.72	4.91	7.62	0.14	0.89	5.19	0.28	4.26	

Initial correlations have been represented graphically with mixed results using total Alkali vs. Silica plots.







Conclusions, to date

Our analyses to date have shown that the peripheral lakes of the Lake Clark Valley contain a valuable record of tephra deposits from regional volcanism and allow the construction of a comprehensive tephra stratigraphy.

Of the approximately 60 tephra samples collected for this study nearly all have been analyzed and their geochemical composition determined. Statistical correlations are in progress and we are approaching the point of confident assessment for correlateable horizons. In support of this geochemical analyses and correlation effort, work will continue in developing petrologic characterizations of sample populations. Further AMS dates of chronologic 'gaps' or otherwise difficult correlations will more closely constrain the ages of the tephra horizons.

Although this study will result in a valuable regional tephra record, many new questions have come about:

1) What affect does settling rate(s) have on tephra composition through single or multiple depositional events?
2) How can we differentiate primary vs. secondary deposition and/or reworking of tephra in the sediment record?
3) Is the assumption of glass shard composition homogeneity valid in distal tephra studies?
4) To what affect does lake chemistry have on the preservation or alteration of glass shards over time?

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